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PROFESSOR JAMES FRANCK
University of Berlin
Sigma Xi—University of California, 1928

SIGMA XI QUARTERLY

VOL. XVI SEPTEMBER, 1928 No. 3

EDITORIAL COMMENTS

ANNUAL CONVENTION, NEW YORK, DECEMBER 27

We present in this number matter that is of great interest both to chapter and alumni members and associates. The reports of the work done during 1927–28 by holders of Sigma Xi grants for that period indicate what the Society has been able to accomplish by its financial aid to competent investigators in important fields. The Committee on Awards makes its announcement of grants for the coming year. While the number of appointees is small, their work is distributed over broad fields and will be done in institutions in all parts of the United States. The five successful candidates were chosen from a group of 20 applicants. We take this occasion to express again the gratitude of the entire organization to the members of the Committee on Awards for the time and thought they have given in making their careful selection from the somewhat large list of candidates from six different countries, namely, United States, Canada, England, China, India, and Czechoslovakia. It is not a simple matter to make a decision when all the applicants are men and women of successful research experience, doing work in important fields and supported by distinguished investigators who know the value of the problem each candidate is studying and whose judgment carries great weight. The selection was made after careful consideration by all the members of the committee.

Attention is specifically called to the article by Donald H. Sweet of Chicago, on "What We Are Doing and Why?" Mr. Sweet is a

member of the alumni committee and the moving spirit in the organization of the Midwest Association of Sigma Xi. His article is the outgrowth first of many comments and criticisms from alumni members and associates who are contributing to the Research Fund of the Society, and second of a prolonged discussion at the Spring Meeting of the Executive Committee on the most effective use of the funds in hand. The National Secretary invites further comments from our membership. The Society is growing. Its organization is being perfected—by which phrase is meant the machinery of the Secretary's office is becoming daily more available for effective use. What is the best way of using it in furthering the object of Sigma Xi, namely, "the promotion of research?" Tell us what you think.

The Executive Committee announces to chapters the following proposed amendment to the Constitution of the Society for action at the December convention: recommended that Article VI, Section 1, be changed to read: "On the reverse side or back of the badge shall be engraved the name of the chapter in which the owner was initiated, together with the date of such initiation, and the owner's name." This omits the sentence: "In the center the numeral of the year in which such chapter was chartered."

The basis for the recommendation is the fact the present form of engraving on the back of the key gives too much space to the date of the founding of the chapter and too little space for the name of the member, the name of the chapter, and the date of the member's initiation.

The next convention of the Society will be held in New York, December 27. With the growth of Sigma Xi and the expansion of its work to include the world-wide alumni movement the conventions have become increasingly important. Not only is chapter representation greatly desired at these annual conferences, but it is important and necessary that delegates be prepared to express opinions and make constructive suggestions about the policies of the organization. Are we moving in the right direction? How can better use be made of our "machinery?" Are we too conservative? Or not conservative enough? In what fields should the Society "promote research?" (See Professor Crew's article in the March QUARTERLY.)

The National Officers suggest that all chapters take up at once on the opening of the academic year the question of their representation at the convention and appoint delegates who will be sure to be present and to participate in the discussions.

The convention is scheduled for four o'clock in the afternoon of December 27, so as to interfere as little as possible with sectional meetings. It will be followed by the annual dinner. The annual address under the joint auspices of the Association and Sigma Xi will be given in the evening. We are most fortunate to be able to announce that the speaker on this occasion is Professor Arthur Compton of the University of Chicago, a recent Nobel Prize winner. His subject will be "What Is Light?"

The Secretary acknowledges the receipt of interesting reports of the year's activities from many chapters and clubs. He hopes to publish excerpts from them in the December number of the QUARTERLY. If that proves impossible, account of them will be given in the Secretary's annual report to the convention. Twenty-one chapters and three clubs have reported as we go to press with this issue. Will secretaries of chapters and clubs, who have not yet sent in their annual report, please do so now? All reports are kept on file in the office of the National Secretary, and are necessary, not only to make the history of chapter and club activities complete, but also to make available at all times current information regarding all our units.

ANNUAL CONVENTION, NEW YORK, DECEMBER 27

WHAT WE ARE DOING AND WHY

DONALD H. SWEET

The use made of the so-called Fellowship Fund of Sigma Xi has recently been the subject of discussion, and of some criticism, from a fairly large number of individuals who have recommended a large number of uses other than its present use. This is the story of one who approached the whole subject almost as an outsider, in a critical frame of mind and with very little definite information, and proceeded to find out a little about what is being done and why.

Under the direction of a competent committee of awards, grants are made in small amounts to a large number of individuals who are carrying on meritorious items of research work and who would not be able to continue without such assistance. That is what we are doing.

ALTERNATIVE USES

Two recommendations as to alternative uses are worth mentioning. One is summed up in the much-abused term "propaganda." A prophecy is ventured that the correct technical definition of "propaganda" in a few more years will be "any attempt by any one to induce some one else to do or refrain from doing something." The proposal is that we indulge in statistical and social research as to the welfare, conditions of employment, earning capacity, etc., of research workers throughout the country. This can be dismissed with the comment that the task outlined is much too great for our resources, and that if we had the resources and started any such activity, we could hardly fail to find ourselves involved in competitive duplication of excellent work along this line by the National Research Council.

One other suggestion is that a portion of the available funds be used to weld the Sigma Xi members into a more homogeneous unit, by publishing a national directory, by enlarging and improving our publications so as to develop a group consciousness on the part of our membership; and, in general, by promoting better acquaintance among the alumni at large, and between the alumni in a given territory and the local university chapters of the society.

It is submitted that a little of this sort of work kept up over a period of a few years, would be of great assistance in putting flesh on the

framework conceived by our founders, and build us up into a power for good and good works, instead of a group of scattered individuals who happened when we were young to win a particular academic honor symbol.

Criticisms

The most plausible of the criticisms of the present use of the Fellowship Fund is, that the grants the committee makes are so small in comparison to those made by some of the great foundations in the country, that they are too insignificant to be taken seriously by any one, and accomplish no worthwhile result. It is because this particular criticism is so plausible as to carry weight with well-intentioned persons not fully informed as to the facts that this communication is being written.

Among the larger foundations it is generally impractical to make small grants. Some one asking the governing body of one of these great institutions for $10,000.00 or $250,000.00 to finance an investigation, receives full consideration of his proposals, while some one asking for $500.00 is briefly told that the foundation is not in a position to take any action on such small items. From a purely administrative point of view, these bodies are so organized as to be incapable of giving to each of two thousand grants totaling $1,000,000.00 the attention each must have to make sure the money is well spent. They find themselves forced to shut the door on such applicants, and to concentrate on two or ten, or, at the most, a score or so of projects that require enough to use up their funds. This leaves the field for meritorious small grants largely unoccupied.

In comparing the merits of large and small grants it is obvious at the outset that the mere size of an appropriation is in itself no guarantee that the money is being used to good advantage. Those in charge of grants of any size will always have to contend with misguided enthusiasm, but with respect to the relative negotiating ability of grantor and beneficiary, and with respect to the ratio of work performed in proportion to money granted, the odds are heavily in favor of the small grant.

An appropriation of $250,000.00 usually means employment for several years for several persons. It may result in great prestige and complete professional success accruing to the individuals in charge of the work. Under such circumstances the natural tendency to put one's best foot foremost is accentuated by the interests at

stake. The Board of Directors passing on the grant are, most of them, busy men with a large number of other interests. In discussing any prospective grant they are confronted with an elaborate and glowing prospectus assembling a huge array of facts that few of them have time to verify in any detail, prepared and presented by a man or group of men whose life work or livelihood or both may be at stake. Obviously, if there is any disparity in knowledge of facts, ability in presentation and debate, and determination to prevail, it is almost certain to be in favor of the applicant.

The large grant ordinarily covers full pay for every hour spent by any one in connection with the work. Not infrequently some of the funds are definitely allotted to newspaper and other forms of publicity that may not contribute anything to the research results.

An appropriation of $500.00 usually helps take care of incidental expenses and equipment for an item in which the worker is interested for its own sake. The time of the worker in charge, who is usually earning a living in other ways and who is often the only person involved, is largely a donation put with the money grant as a joint contribution to the desired result. No one can make a living, much less a competency or a reputation, out of the operation of such a grant alone. After the results are achieved a career may perhaps be based upon them, but this is a later development depending on the results of the research, not on the mere award of the grant. These considerations, combined with the social and professional standing of the grantee, afford an excellent guarantee against the successful solicitation of such grants for motives that are entirely or chiefly sordid.

This relative immunity from abuse and this partial support of the real total of expenditures, both tend to explain and corroborate the general impression that, in proportion to the funds expended, the small grant brings in a far greater yield of valuable research than the large grant.

The writer's conclusion on this point is: First, that while large grants are no doubt necessary for large projects, he would rather see his $3.00 put into grants of the approximate size now being made; second, that he knows of no contribution he makes to welfare purposes where the results are more gratifying in proportion to the amount contributed.

One other criticism warrants brief notice. The specific allocation of the grants among different fields of research has been criticized.

It is enough on this point to state that the American Association for the Advancement of Science, and several other groups, are making small grants in the same way we are; that applications aggregate many times the total available for distribution; and that each committee obviously goes over all the applications submitted and tries to select the most meritorious ones. If the author of such criticism will send in a few worthwhile items in the field he does not wish the committee to neglect he will go farther toward correcting the defect he deplores than in any other way.

The writer himself feels that one of the most worthwhile fields has been badly neglected and will now put preachment into practice:

WANTED—some worker in the social and administrative sciences, to work out the personnel problem for the efficient administration of an endowment of $20,000,000.00, all of the income from which is to be expended in small grants to further research work.

What we have observed so far is that endowment has been diverted from small grants to less efficient large ones by administrative difficulties. With the administrative obstacles removed, the endowment mentioned above would not be far to seek.

Any person of proper qualifications ought to find little difficulty in securing a small grant from any one of several organizations to assist him in working out this problem. The result, if successful, might make the basis of career. It is believed a successful solution would remove the chief and perhaps the only obstacle in the path of many right-minded and conscientious men who feel urged by what they see of the world they live in to "Gather up the fragments that remain, that nothing be lost."

As for the present utilization of the Fellowship Fund, it seems to be an initial step toward one of the few things Sigma Xi ought to be able to do better than almost any other kindred organization, and the writer can only wish we were doing ten times as much of it. It is indeed a thought from which much warmth and comfort springs, that in a field where the most invaluable fruits are of a species that tends to blossom here and there in out of the way corners and byways, there are gleaners aware of the scattered and delicate nature of the crop, on the lookout to nurture and harvest it in ways suited to its needs.

Chicago, May, 1928.

PROFESSOR JAMES FRANCK

R. T. Birge

Another internationally known scientist has been added to the list of members of Sigma Xi in the person of Professor James Franck of the University of Berlin. He was awarded the degree of LL.D. at the Charter Day exercises of the University of California last March and elected to membership in the chapter there.

Professor Franck was born in 1882. From 1906 to 1911 he was an assistant in physics, Berlin University, and from 1911 to 1914 Private Docent in the same. During the war he served in the German army. From 1918 to 1920 he was in the Kaiser Wilhelm Institute of Physical Chemistry, Berlin. Since 1920 he has been professor of physics and Director of the Second Physical Institute in the University of Göttingen. In 1925, he received the Nobel Prize jointly with Dr. G. Hertz, his collaborator.

Professor Franck was the first to employ impacts of electrons with atoms to measure the energy levels existing within atoms, attaining thereby a verification of the Bohr theory of atomic structure. With profound theoretical insight and great experimental skill, he has carried out extensive investigations of the conditions under which energy may be transferred to and from atoms by light quanta, electrons, and other atoms. His explanation of molecular spectra has led to the calculation from spectroscopic data of the energy of dissociation of molecules into atoms. His investigations have been of fundamental importance to both physics and chemistry, and the phenomena he has studied represent a reduction of chemical reactions to their simplest terms.

He is a man of charming personality, bearing modestly his distinguished position in the scientific world. His friendly and ungrudging council has been a source of great inspiration to the many students from both Europe and America who have worked in his laboratory.

REPORTS OF HOLDERS OF SIGMA XI GRANTS FOR 1927-28

PROFESSOR EDWARD S. C. SMITH, UNION COLLEGE

Professor Smith has been studying for some time the great Ktaadn granite area in Maine. In the *American Journal of Science* for January, 1928, and again for June, 1928, reports are published of the results of his investigations which were aided by Sigma Xi grants. The first report is on "A Possible Tillite from Northern Maine." For about four miles along the river bank in Penobscot county, deposits are of sandstones, slates and conglomerate, representing relatively shallow water deposits which have been severely folded, crumpled and crushed. This and an accompanying slaty cleavage is well displayed in the small gorge of Bowlan Brook, near its confluence with the Penobscot's East Branch. Recognizable fossils are not found here, but rather suggestive nodules in a layer of sandstone leads to the belief that metamorphism has destroyed their traces rather than that the series was ever barren of organic remains. At Haskell Rock Pitch a conglomerate was investigated, which showed little or no bedding, and decided heterogeneity of deposit, both as to size and kind of rocks represented by pebbles. This wide variety and lack of sorting suggested a tillite to Professor Smith and because of certain definite features observed which are characteristic of tills and tillites, the inference is drawn that the conglomerate studied is of glacial origin. The suggestion is made that the age of the rock and its associated formations is Silurian. It is certainly pre-Oriskany.

The later published article is under the title: "The Cambrian in Northern Maine," and gives the results of a later laboratory study of some of the red slates collected during the field study described in the first report. The investigation revealed abundant remains of the little known genus *Oldhamia*—a good Cambrian guide fossil. This is the first identifiable Cambrian form to be reported from the state of Maine, and it furnishes evidence of the existence of a Cambrian, probably lower Cambrian, sea way in Northern New England. The close similarity of the New York and Maine specimens together with the fact that they both appear in reddish slates suggests that the

sea way extended entirely across New England, including also Eastern New York.

MRS. MATILDA MOLDENHAUER BROOKS, UNIVERSITY OF CALIFORNIA

"Through the generosity of the Sigma Xi Research Grant I have been enabled to continue my studies on the penetration of methylene blue and other oxidation-reduction indicators into living cells. The green alga, *Nitella*, was used. This plant is well adapted for direct studies in penetration inasmuch as the sap can be extracted in an uncontaminated condition and analyzed colorimetrically. In this way the rates at which these dyes penetrate living cells can be easily followed. By placing the plants in solutions of these dyes, and by varying the pH value, temperature and concentrations, the laws underlying the penetration of these substances have been studied.

"The work is still in progress and conclusions have not yet been formulated.

"I wish to express my deep gratitude to the Committee for the aid rendered me in my work."

DR. HELEN SOROKIN, UNIVERSITY OF MINNESOTA

Dr. Sorokin publishes in the *American Journal of Botany* for December, 1927, an illustrated article on "Variation in Homœotypic Division in Ranunculus Acris." Material for the study was collected during several years and in different localities. Sections were cut rather thick, varying from 15–18 microns. This was necessary in order to obtain complete uncut cells. Heidenhain's iron-alum hæmatoxylin was used for staining, and both camera lucida drawings and photomicrographs were made.

Among the results of the investigation are the following:

Two different types of homœotypic division are found. One type corresponds very closely to the typical homœotypic scheme with the reduced number of chromosomes appearing as very distinct units during the equatorial-plate stage. The chromosomes have in this case the size and shape of the somatic chromosomes.

During the second type of the homœotypic division the chromosomes become associated end-to-end into thick strands at opposite poles, and their double nature is persistent for a certain time. After this the twofold aspect is lost, and the strand assumes the shape of a letter S, or a figure 6.

During the metaphase of the second type of the homœotypic division the individual chromosomes are not distinct. Two compound thick chromatin structures, each having the shape of the letter V or of a horseshoe, occupy the positions of the two equatorial plates of a microsporocyte. The compound structures are either entire or constricted. Two, three, or four separate segments are sometimes found, but an entire compound chromatin structure seems to be the prevalent condition in each of the daughter nuclei.

During the anaphase of the homœotypic division each of the compound chromatin structures splits longitudinally and each of the split parts is either distributed to opposite poles as an entire structure, or is segmented first into three or four segments and the latter distributed to the opposite poles.

The reconstruction of the granddaughter nuclei during the telophase proceeds in the usual way. The compound chromatin structures segment and become alveolized.

Certain materials exhibited an intermediate type of homœotypic division. In this type distinct chromosomes appear during the metaphase, but these chromosomes are entirely different in size and shape from the somatic, and they resemble very closely chromosomes present during the metaphase of the heterotypic division.

It was impossible to determine which of the types described is the prevalent type, or the conditions under which these different types occur.

PROFESSOR OSCAR W. RICHARDS, CLARK UNIVERSITY

Professor Richards reports as follows on a study of "The Growth of Populations of Yeast."

"The financial grant from the Committee on Awards of the Society of Sigma Xi permitted the completion of experiments which lead to the following conclusions: The growth of a population of yeast is potentially unlimited and continues at a *constant* rate as long as the environment is maintained effectively constant. The limit of growth found in the actual experiments was limited only by the efficiency of the methods used to keep the culture medium effectively constant. The usual test-tube cultures of *S. cerevisiae* grow at a constant rate for about 30 hours after seeding. At this time an alcohol concentration of about 1 mg. per cc. is associated with the beginning of the decline in the rate of growth. Carbon dioxide, pyruvic acid, and

other excretion products also retard the rate of growth but subsequent to the effect of the alcohol.

"Consequently, when the food is adequate, the sigmoid part of the growth curve after the point of inflexion is merely a measure of the inhibiting effect of the toxic waste products of the cells, excreted into the environment. The necessity of maintaining a constant rate of growth in studies on the relation of yeasts to vitamines and other products is emphasized.

"The changes in the distribution of the sizes of the cells during the cycle of the growth of the population were next investigated. This study indicates that the larger buds are injured selectively by the toxic excretion products of the yeast after they are independent of the mother cell and before they are able to acquire sufficient resistance to withstand the unfavorable environment.

"The rate of multiplication of yeast at different temperatures was determined. Abnormal elongate cells were found to occur at 30° C. More of these unusual forms occurred when the temperature was maintained within a variation of only a few hundredths of a degree from the temperature of 30° which disturbs the normal formation of buds. The importance of this unfavorable temperature zone is stressed because it occurs at a temperature usually used as a normal temperature in investigations with yeast.

"Most of the experiments were made in the Laboratory of General Physiology at Harvard University where the writer received many courtesies from Dr. W. J. Crozier for which he wishes to express his appreciation. The rest of the experiments were made in the Department of Biology of Clark University."

Miss Joyce Hedrick, of Miami University

Miss Hedrick had been associated with Dr. Fink in the preparation of his manual on "Lichen Flora of the United States," and was allowed the Sigma Xi grant originally awarded to Dr. Fink, who died suddenly a year ago. Miss Hedrick reports as follows:

"During the college year of 1927–28, 100 descriptions have been done on the grant of $300 from Sigma Xi. Between 150 and 200 lichens from West Virginia, North Carolina and Washington have been determined.

"The work has moved slowly and countless hours have been spent in correspondence. Dr. Alex. Zahlbruckner is working in Europe. It has been necessary to go over the plans for his work several times.

The work on descriptions of species should be finished early in the coming year if Zahlbruckner comes through with his work. At present it appears that the manual should be in the publisher's hands not more than a year later than Doctor Fink had planned."

Mr. Floyd L. Winter, University of Illinois, College of Agriculture

Mr. Winter made a study of the Illinois chemical strains of corn and has submitted the following abstract of the results of his investigations:

PART I. THE MEAN AND VARIABILITY AS AFFECTED BY CONTINUOUS SELECTION FOR CHEMICAL COMPOSITION IN THE MAIZE GRAIN

In 1896, a series of breeding experiments was begun at the Illinois Agricultural Experiment Station to determine whether the chemical composition of maize could be influenced by selection. One hundred and sixty-three ears of a variety known as Burr's White were used as the foundation stock from which selections were made in four different directions: namely, for High Oil, Low Oil, High Protein, and Low Protein.

These four strains were carried on in the same way and in the following manner: in the High Protein, for example, the 24 ears highest in protein were selected for seed and planted in an isolated plot, each ear in a separate row. These rows were harvested separately and the seed for the next crop selected from the ears which were found to be highest in protein. Nine years later the system was modified somewhat in an attempt to prevent loss of vigor by inbreeding. Alternate rows were detasseled and seed selected only from the highest yielding detasseled rows. In 1921, this system was again modified to reduce the amount of inbreeding. Two seed ears were taken from each of the detasseled rows regardless of yield. The High Oil, Low Oil, and Low Protein were similarly conducted, selection being made each year of ears highest in oil, lowest in oil, and lowest in protein, respectively.

Continuous selection over a period of 28 years for protein and oil content in corn has produced four types which are distinctly different in their composition. When compared with the original non-selected material, the High Protein and High Oil show a proportional increase of 50.01 and 109.79 per cent, respectively. The Low Protein and the

Low Oil show a proportional decrease of 23.26 and 67.87 per cent, respectively.

Variability, as measured by the standard deviation, Weinberg's formula, and the extra-modal coefficient, increases as selection leads to a high mean and decreases as selection leads to a low mean. Variability in protein and oil content, in the Illinois chemical strains of corn, appears to depend upon the magnitude of the mean of the selected character.

Variability may be due to two different causes, namely, genetic and non-genetic. Genetic variability results when the population is made up of different genotypes. The non-genetic variability is due to the varied expression of the interaction of the environment with the genetic factors in producing a character.

Selection for a given type is expected to decrease the genetic variability. This decrease in variability of the population is brought about by a reduction in the per cent of heterozygous individuals. After the population becomes homozygous for the selected character no further reduction in variability through selection can be expected. The variability that still remains is attributed to environment. The degree of variability due to the environment probably depends upon the amount of material present for the environment to interact with.

In the Illinois chemical strains of corn, selection has rendered the strains more nearly homozygous as indicated by: (1) the reduction of the ancestry to a single ear for each strain; (2) the fact that upon selfing, a condition of uniformity is reached more quickly than with open pollinated varieties. Hence, the four chemical strains are likely less variable genetically now than the original non-selected material. It follows, then, that the apparent increase in variability of the high strains is due to environmental influence. This, however, cannot be proved because it is impossible to analyze the inheritance of protein and oil content on a genetic basis with the data at hand.

The extra-modal coefficient used to measure variability was obtained by dividing the per cent of the population lying outside of the modal class by the per cent of the population lying in the modal class. The larger the quotient the greater the variability.

The symmetry of the distribution curves as determined by the percentile method for the four different strains of corn taken at periodic intervals shows that the curves do not differ significantly from the normal variability curve.

PART II. THE INDIRECT EFFECT OF SELECTION UPON CERTAIN EAR AND GRAIN CHARACTERS AND THEIR RELATION TO ONE ANOTHER

In selecting for chemical composition of grain in the Illinois chemical strains of corn many of the ear and grain characters have been affected. The circumference of ear and of cob both at the butt and at the tip, the number of kernels per row, and the weight of ear and of cob have been reduced. Selection for Low Oil, and for High Protein content has been followed by a reduction in length of ear. This reduction in ear characters is attributed mainly to the reduction in vigor of the strains following close breeding.

The high strains have smaller kernels than the low strains. The High Oil has the smallest grain and the largest germ while the Low Oil has the largest grain and the smallest germ. The endosperm of both the High Protein and the High Oil has a hard, oily, translucent appearance, whereas the endosperm of the Low Protein and of the Low Oil has an opaque, floury appearance.

The per cent of protein in the High Oil is greater than that in the Low Oil. There has been but little change in this content since 1903. The High Protein has a greater per cent of oil than the Low Protein. However, the oil content has decreased in both strains since 1903.

All correlations between ear characters and composition of seed and of crop appear to be due to non-genetic factors.

Composition of grain of seed ears is significantly correlated with similar composition of grain in the crop.

REPORT OF THE COMMITTEE ON SIGMA XI GRANTS FOR 1928–29

Qualifications and credentials of twenty applicants for Sigma Xi grants for 1928–29 were given careful consideration. The committee recognizes the value and importance of the suggested problems, and the ability and successful experience of the candidates. It is interesting to note that the proposed problems cover broad fields, and that the candidates apply from many parts of the world—China, India, Czechoslovakia, England, as well as Canada and the United States.

The committee recommends awards to the following:

Dr. A. Elizabeth Adams, $200

Dr. Adams is Professor of Zoology at Mt. Holyoke College, and is studying the effect of double pneumectomy on Triturus. The award is to be used for microphotographs, technical supplies and assistance.

Miss Joyce Hedrick, $300

Miss Hedrick has been collaborating with Dr. Fink of Miami University in the preparation of a Manual of Lichens of the United States. She is therefore the one best qualified to continue the work and bring the important manual to publication. The Sigma Xi grant is accompanied by a grant of similar amount from Miami University and meets in part Miss Joyce's personal expenses.

Professor Edward Mack, Jr., $170

Professor Mack is in the Department of Physical Chemistry of Ohio State University and is investigating the vapor pressures and heats of vaporization of crystals of organic compounds. The award is to be used for the purchase of an oil pump of large capacity with a $1/4$ H. P. motor.

Professor Carl L. A. Schmidt, $750

Professor Schmidt is Professor of Biochemistry at the University of California and is the author of some sixty articles in Biochemistry. The award is to be used in connection with a study of combinations of proteins and dyes.

MR. ARTHUR A. VERNON, $750

Mr. Vernon is in the Graduate School at Princeton, where he is continuing a study of photo-chemical reactions sensitized by the excited cadmium atom. The award is for personal expenses.

E. L. THORNDIKE, *Columbia University*

JOHN L. NORTHRUP, *Rockefeller Institute for Medical Research, Princeton*

W. R. WHITNEY, *Research Laboratory, General Electric Company, Schenectady, N. Y.*

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